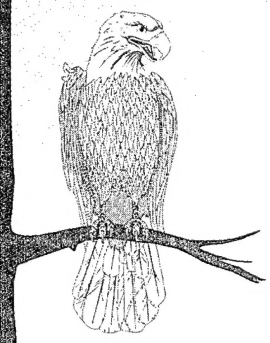

US Army Corps of Engineers

Compilation and Review of Completed Restoration and Mitigation Studies in Developing an Evaluation Framework for Environmental Resources

Volume I

Evaluation of Environmental Investments Research Program

April 1995
IWR Report #95-R-4

COMPILATION AND REVIEW OF COMPLETED RESTORATION AND MITIGATION STUDIES IN DEVELOPING AN EVALUATION FRAMEWORK FOR ENVIRONMENTAL RESOURCES

VOLUME I

by

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Evaluation of Environmental
Investments Research Program

IWR Report 95-R-4
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PREFACE

This study was conducted as part of the Evaluation of Environmental Investments Research Program (EEIRP). The EEIRP is sponsored by the Headquarters, U.S. Army Corps of Engineers (HQUSACE). It is jointly assigned to the U.S. Army Engineer Water Resources Support Center (WRSC), Institute for Water Resources (IWR) and the U.S. Army Engineer Waterways Experiment Station (WES), Environmental Laboratory (EL). Mr. William J. Hansen of IWR is the Program Manager and Mr. H. Roger Hamilton is the WES Manager. Technical Monitors during this study were Mr. John W. Bellinger and Mr. K. Brad Fowler, HQUSACE. The field review group members that provide complete Program direction and their District or Division affiliations are: Mr. David Carney, New Orleans; Mr. Larry M. Kilgo, Lower Mississippi Valley; Mr. Richard Gorton, Omaha; Mr. Bruce D. Carlson, St. Paul; Mr. Glendon L. Coffee, Mobile; Ms. Susan E. Durden, Savannah; Mr. Scott Miner, San Francisco; Mr. Robert F. Scott, Fort Worth; Mr. Clifford J. Kidd, Baltimore; Mr. Edwin J. Woodruff, North Pacific; and Dr. Michael Passmore, Walla Walla. The work was conducted under the Evaluation Framework Work Unit of the EEIRP. Ms. Joy Muncy of the Technical Analysis and Research Division (TARD), IWR and Mr. Jim Henderson of the Natural Resources Division (NRD), WES are the Principal Investigators.

The work was performed by Planning and Management Consultants, Ltd. (PMCL) under Task Order 0060, Contract No. DACW72-89-D-0020 managed by Ms. Joy Muncy. Dr. Timothy Feather was the principal investigator in collaboration with Mr. Donald Capan. Dr. James Heaney of the University of Colorado and Dr. John Langowski of PMCL provided technical guidance and support.

The report was prepared under the general supervision at IWR of Mr. Michael R. Krouse, Chief, TARD; and Mr. Kyle E. Schilling, Director, IWR; and at EL of Dr. Robert M. Engler, Chief, NRD and Dr. John W. Keeley, Director, EL.

This report is built upon the experience and perspectives of many people from the Corps State and Federal resource agencies, and local interests. Their time and responsiveness to the research activities involved in this study are respectfully acknowledged.

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I. INTRODUCTION

ENVIRONMENTAL INITIATIVES

The U.S. Army Corps of Engineers (Corps) is embarking on a heightened level of environmental service. This additional focus accommodates the changing perspectives of the American public toward environmental enhancement which has caused Congress to authorize funds for construction of environmental projects through legislative actions. The Corps, as a manager of major land and water resources throughout the U.S., has been a recipient of political urgings toward environmental restoration and mitigation endeavors.

Many would argue that the Corps has been attentive to environmental concerns in its history, for example through the environmental quality (EQ) account in Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies (P&G, U.S. Water Resources Council 1983). Additionally, many Corps reservoirs serve multiple purposes, such as flood control and recreation. Because many recreationists using Corps reservoirs have enjoyed their experiences, the Corps is perceived by a segment of the public as being responsible for environmental promotion and pleasure. This new era is different though—it involves water resource development for the sake of the environment, not as an auxiliary or secondary benefit category. Policy guidance coming from the Assistant Secretary of the Army for Civil Works and Corps Headquarters (HQUSACE) direct environmental restoration to be a priority project output.

The related analytical challenge posed to the Corps planning community is how to evaluate and design the optimal environmental project and how to select the optimal set of environmental projects to build. This is not a subtle challenge. Leonard Shabman, who examined the policy and procedural implications of the Corps' enhanced environmental role in Environmental Activities in the Corps of Engineers Water Resources Program: Charting a New Direction (1993), suggests:

> *The Corps has a rich heritage of commitment to a systematic and uniform evaluation as a way of considering the social merit of public actions.*

Historically, this ideology has led the Corps to making project planning decisions based on economic value. Justifying water resource projects on their contribution to National Economic Development (NED) is fundamental to the P&G and is inherent to the project planning in the

Corps. NED means of justification have generally been politically acceptable. Technically, NED justification has resulted in a variety of models, guides, and computer software. Benefit-cost analysis is considered a standard technique and the Corps has published a series of NED guides designed for planners to evaluate the benefits and costs of proposed water resource projects. The problem and related challenge is that environmental projects provide features that cannot readily and/or consistently be described in monetary terms. Thus, the decision-criteria and related techniques used by Corps planners are not entirely suitable for environmental project plan formulation.

UNDERSTANDING THE CHALLENGES: FOCUS OF THE STUDY

The chief motivation for the present study is the Corps need to develop planning tools to accommodate the new environmental mission. The Corps, for many decades, has been a world leader in water resource development, but generally with an industrial atmosphere. The movement toward environmental-type projects raises the need for the Corps to better accommodate this enhanced service.

Currently, there is a lack of methods and processes within the Corps planning community for assessing the efficiency and effectiveness of investments in environmental restoration, protection, and mitigation. The Corps Evaluation of Environmental Investments Research Program (EEIRP) is designed to develop analytical methods and models for such issues as determining environmental objectives and measuring outputs and cost-effectiveness analysis. The specific research work units of the EEIRP are shown in Table I-1. The broad goals of the EEIRP are to develop analytical tools to assist planners, managers, and regulators in addressing the following two statements which are referred to as the site and portfolio questions, respectively:

(1) How can the Corps determine whether the recommended action from a range of alternatives is the most desirable in terms of the environmental objective being addressed?

(2) How should the Corps allocate limited resources among many "most desirable" environmental investment decisions?

The new tools that are being developed under the EEIRP need to be housed in an overall evaluation framework that effectively utilizes the data, model results, and other inputs in the plan

TABLE I-1

EEIRP WORK UNITS

- Determining and Describing Environmental Significance
- Determining Objectives and Measuring Outputs
- Objective Evaluation of Cultural Resources
- Engineering Environmental Investments
- Cost Effectiveness Analysis Techniques
- Monetary and Other Valuation Techniques
- Incorporating Risk and Uncertainty into Environmental Evaluation
- Environmental Databases and Information Management
- Evaluation Framework

selection process. The P&G and evolving environmental guidance provide a conceptual and general framework, but more operational guidance and processes are required. Therefore, one of the major goals of the EEIRP is to develop an operational framework that will insure the products of this program are incorporated into the site and portfolio questions.

The present study, which falls under the *Evaluation Framework* work unit in the EEIRP, is an initial data gathering effort to identify the important planning issues presently being faced by Corps planners. The ultimate intent of the *Evaluation Framework* work unit is to develop a framework that allows for the appropriate combination of interagency input, analytical processes, and technical data considered during the evaluation activities of a given project. The specific objectives of this work unit are to:

(1) Provide a process to systematically identify national, regional, and local objectives and priorities.

(2) Identify information needs of the public, sponsors and decision-makers, and study participants and appropriate communication media.

(3) Develop and describe trade-off processes incorporating all benefits and costs including opportunity costs.

(4) Identify appropriate processes for facilitating public, organizational, and institutional involvement.

Although the Corps planning situation for environmental projects is in a transient state, Corps Districts are faced with servicing the present environmental needs of their constituencies. This is being met with varying degrees of success from the perspectives of the Corps planner and local interests. Monitoring the recent past and real time environmental endeavors of the Corps reveals that, although there is cumbersomeness in the planning arena, some successful techniques are emerging. Also, close evaluation of the plan formulation activities of these projects helps to identify the grass roots planning issues that should be considered as the Corps develops standard planning tools and an evaluation framework for environmental projects.

Therefore, this research effort employed an extensive interview process of individuals and organizations who have participated in Corps environmental projects during the formal planning process. Ten project case studies and a workshop with HQUSACE personnel were used in this study to identify specific planning challenges and means of handling the challenges. Furthermore, these research activities were drawn upon to identify important attributes of an evaluation framework for Corps environmental projects.

ORGANIZATION OF REPORT

This report describes the research activities conducted in this study, describes the results, and makes concluding recommendations for future research. It is produced in two volumes to accommodate the considerable amount of data and supplemental information acquired from the case study process. Volume I contains Chapter I through IV. Chapter I provides an introduction to the project, the EEIRP, and the goals of this study. Chapter II summarizes the approaches to gathering the information from stakeholders critical to the evaluation process. Chapter III provides the comparative analysis which identifies the important themes that emerged through the data collection efforts. Themes are presented by EEIRP work unit and then according to the perspectives of the stakeholders involved in the process. Chapter IV makes recommendations of attributes of an evaluation framework for environmental projects and also outlines future research needs. Volume II contains the supporting information for the analysis, including the case study write-ups, a workshop letter report, resource listings, and other information collected during the case study process.

II. RESEARCH ACTIVITIES

GENERAL APPROACH

The intent and design of this project was to survey environmental practitioners to identify issues that need attention in environmental project plan formulation and evaluation. Major partners in the planning process are shown in Figure II-1. Each partner has specific needs, expectations, and expertise that contribute to the planning process and the eventual development of the environmental project. The Corps is typically expected to facilitate the process, communicate technical and policy information to partners, and provide technical guidance on project design features. In many cases the U.S. Fish and Wildlife Service provides some technical information for the project design or baseline conditions. Interest groups and local

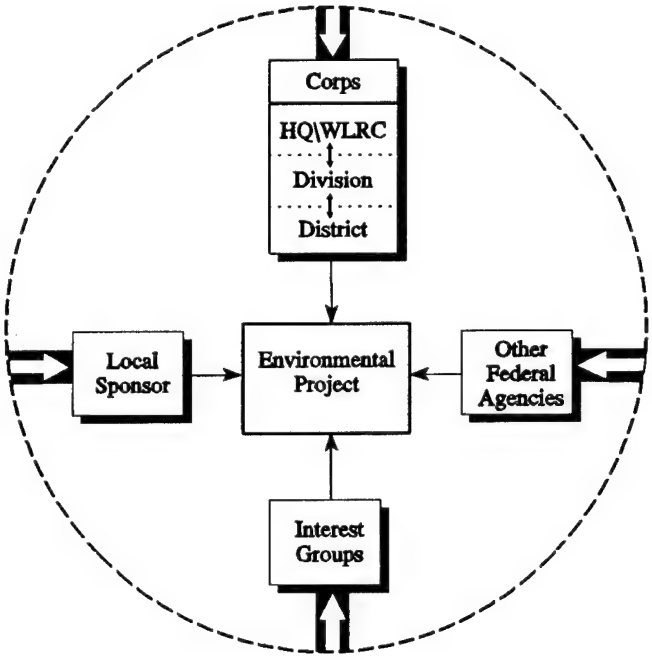

FIGURE II-1
MAJOR PARTNERS IN THE PLAN FORMULATION PROCESS

sponsors are typically the grass roots organizers or motivation behind the project. The major partners are both givers and receivers of information and, in most cases, all need to communicate with one another. This is illustrated by the dashed circle that encompasses all the partners. There is also a very important element of consensus-building in the plan formulation process. Thus, the communication aspects and information exchange are crucial in creating a project that meets the diverse needs of the affected public. Given the participation of many parties in environmental planning, this research involved the collection of insights from the perspectives of the major partners.

Information and data for this project were collected through two research activities. The first was a facilitated workshop held with Corps Headquarters personnel involved in environmental project selection and approval. The second research activity involved case study analysis of selected Corps environmental projects, the main activity being interviews of study participants. The format and research activities of the workshop and the case studies are provided in the next two sections. The results of the activities are presented and analyzed in Chapter III.

WORKSHOP WITH HEADQUARTERS PERSONNEL

The workshop was held with members of Headquarters at Fort Belvoir, Virginia, on March 18, 1994. Personnel from the IWR and WES also attended the workshop. The objectives for the facilitated workshop were to examine what is observed, explained, and desired in the review of environmental restoration project documentation. Comparing documentation of the perspectives from Headquarters with the needs, observations, and perspectives from the field provides a very insightful angle on the evaluation framework. This process has tremendous implications on the efficiency of the approval process for proposed environmental projects.

The workshop consisted of four sessions. The first three sessions were used to generate lists of available and needed information pertaining to decision-making criteria with each session focusing on one of these questions:

- *What are the key criteria or issues you use to evaluate environmental studies?*
- *What information has been effective in the past in evaluating environmental studies?*
- *What new/additional information would be effective in evaluating environmental studies?*

The fourth session used information created in the first three sessions and directed the participants to cross-reference existing or needed information with criteria that it supported in a matrix.

The results of the four workshop sessions were summarized in a separate document provided in Appendix A of Volume II of this report. The basic themes and arguments made during the workshop are discussed further in Chapter III.

ENVIRONMENTAL PROJECT CASE STUDIES

The second data collection activity, the case study analysis, was the dominant research focus of this effort. Since the ultimate intent of EEIRP is to provide tools for planners responsible for environmental projects, a very suitable task is to understand the issues and challenges actually faced by planners. Ten case studies of existing Corps environmental projects were conducted, with the goal of understanding the planning issues of each case study. Common themes that link or discriminate the challenges that planners face were identified, as were means of responding to the challenges.

Selection of the ten case study projects, which are identified in Figure II-2, involved the consideration of several criteria. The aim was to get a reasonable sampling of the types of environmental projects of which the Corps is involved. To limit any regional bias the ten projects were geographically dispersed, as is illustrated in Figure II-2. This ensured that the perspective of one Corps District did not dominate the response set. The types of environmental projects examined also varies geographically. It was important to get a good cross-section of environmental management challenges in terms of the physical setting.

Another major criterion in selecting the case study sites was to examine projects funded under different authorities. Half of the projects (Fern Ridge Lake, Galilee Salt Marsh, Homme Lake, McFaddin Ranch, Yolo Basin Wetland) are funded under Section 1135 of the Water Resources Development Act of 1986. These are characterized as smaller projects that have an abbreviated planning process. Two of the case study sites were authorized under regional, multiagency environmental restoration and protection programs. The Pool 8 Restoration Project was authorized under the Upper Mississippi River System Environmental Management Program (UMRS-EMP) and the La Branche Marsh Project was authorized under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) which is aimed at restoring and protecting coastal Louisiana. Special project-specific legislation was authorized for the reexamination of three projects (Jackson Hole, Kissimmee River, Mayfield Creek).

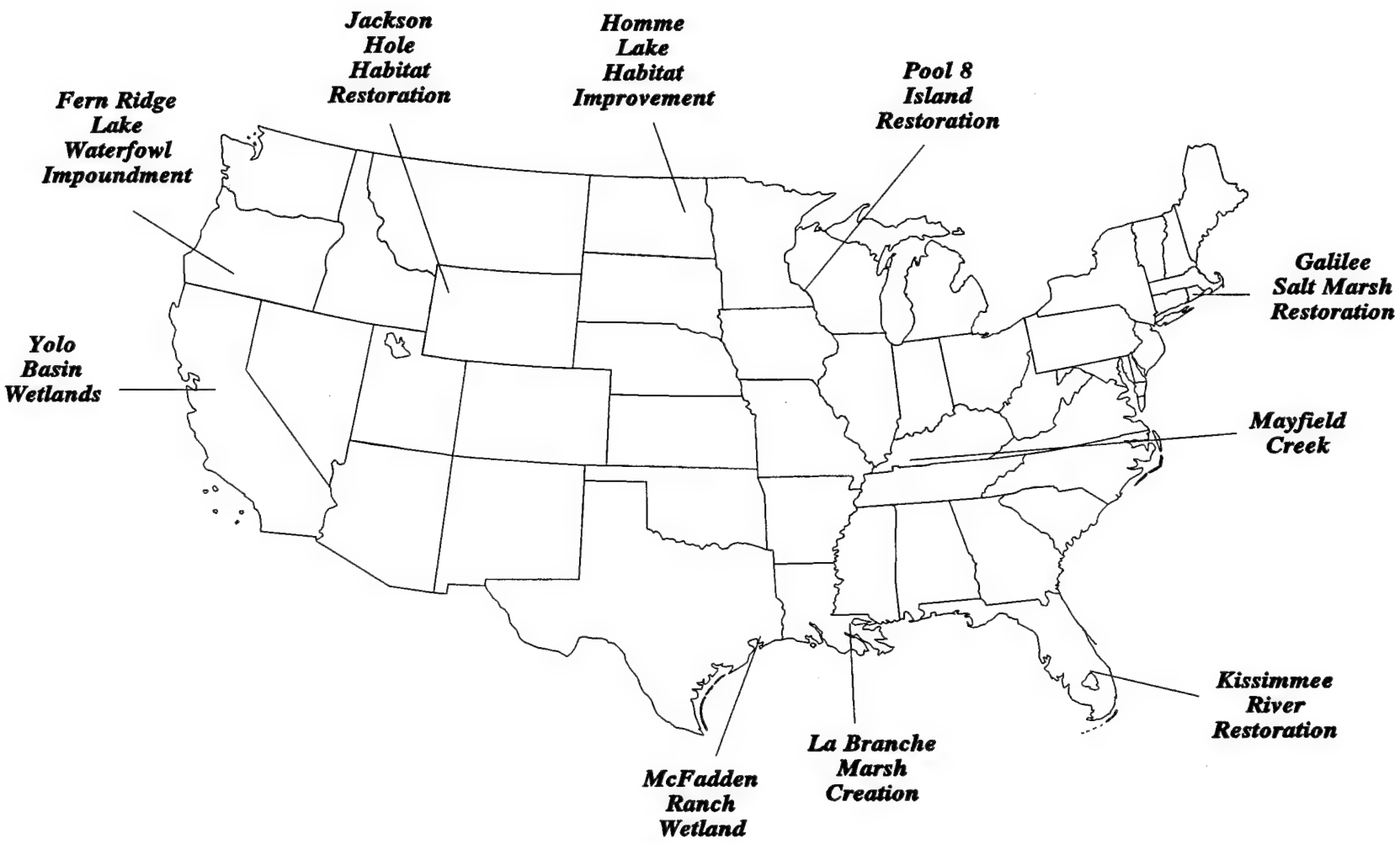

FIGURE II-2
ENVIRONMENTAL PROJECT CASE STUDY LOCATIONS

Most of the projects examined were in an advanced planning stage (feasibility) and some were built or under construction. The Jackson Hole Project was in an early planning stage (reconnaissance). This variability in the development stage was sought in case study selection to address the varying levels of planning detail required at each stage.

Willingness of the planners to participate was also considered in the site selection. Sometimes the situation was such that key personnel could not be scheduled for interviewing. There were also other situations that made participation especially burdensome. Significant effort was put forth toward accommodating the schedules and preferences of those participating in the interviews.

The interview instrument was designed based upon the EEIRP work units and how they interact with the plan formulation process. The traditional plan formulation process is shown by the rectangular elements in Figure II-3. This basic procedure is used by the Corps for planning any type of water resource development. The EEIRP topics, shown as elliptical elements in Figure II-3, are meant to create analytical procedures that will supplement the plan formulation process for environmental projects. Accordingly, each EEIRP work unit topic received attention during the interviews. The interview instrument underwent extensive review by personnel from the IWR and WES, especially those involved with EEIRP. The final interview instrument used to guide the interviews is provided in Appendix B of Volume II.

The first of the series of interviews was held in April and the final interview was completed in early October. The Corps study manager at each site was designated as the point of contact for identifying the participants that played a role in the development of the project. Those identified were contacted by telephone and asked if they would grant an interview. Background material, including feasibility reports, memorandums, and technical documentation, were reviewed by the interview team to prepare for the interviews. A trip was made to each location to conduct the interviews and an attempt was made to personally interview all participants. Telephonic interviews were conducted with those who were unavailable during the site visits.

Following the interviews, the data were analyzed and arranged according to the EEIRP work units. This information is presented in a narrative format which highlights the findings, discusses the views of respondents, and lists the respondents' recommendations for research. The case study reports are found in Appendix C of Volume II, and any additional information that was gathered during the study process is located in Appendix D. Analysis of the case study results for recurring themes and recommendations are covered in the remaining chapters of Volume I.

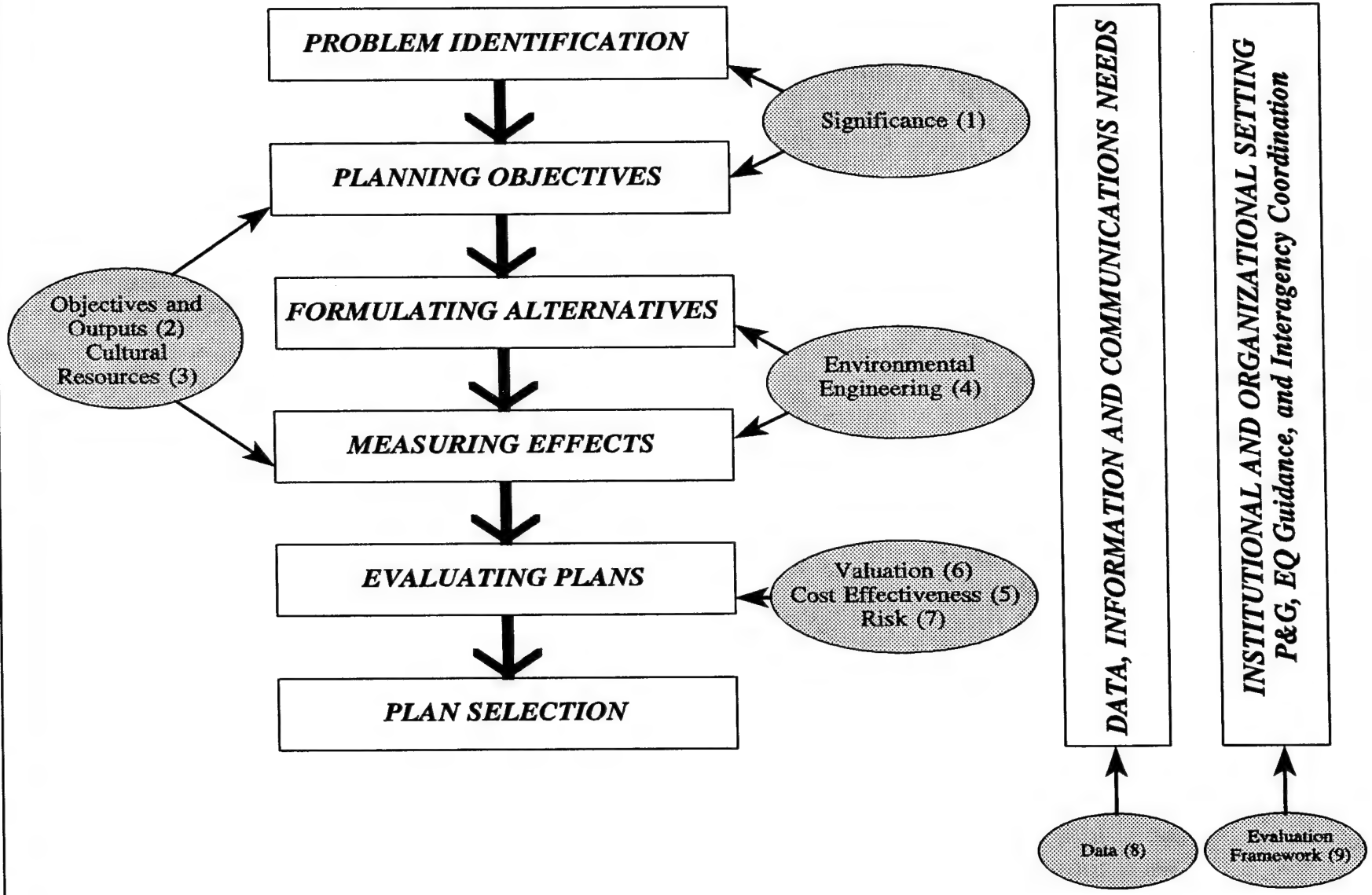

FIGURE II-3
EEIRP SUPPORT FOR ENVIRONMENTAL PLAN FORMULATION AND EVALUATION

III. RESULTS AND COMPARATIVE ANALYSIS

INTRODUCTION

The data collected from the case study interviews and the HQUSACE workshop provide a considerable amount of valuable information. At the very least, the process commanded the attention of professionals who have experience in environmental planning and who will likely be impacted by the products developed under the EEIRP. This opportunity to retrospectively examine a project or planning situation, with the focus on improving the environmental planning process as a whole, is an event that cannot normally be afforded, given real-time commitments. The interview and workshop activities formally allowed for information to be offered and recorded for further analysis. At the completion of the research activities, approximately 100 people spent an average of one and a half hours discussing the Corps plan formulation process for environmental projects. This survey of the issues by those responsible for developing environmental projects provides a reasonable foundation for developing "how to" planning guidance.

Along with the survey of issues, the case studies brought forth important lessons-learned, some of which are readily transferable to other planning situations. The reader is encouraged to read the case studies provided in Appendix C in Volume II. A list of references collected throughout the interview process is found in Appendix D in Volume II, some of which were especially useful in the planning process described in the case studies.

The focus of this chapter is to draw upon the case study and workshop results to identify trends in responses and emerging themes. The first discussion focuses on the major issues that were surfaced for each EEIRP work unit. This is followed by a presentation of the dominant issues according to the perspectives of the major stakeholders, including HQUSACE, District, Division, other Federal agencies, and local sponsors and interest groups.

ANALYSIS BY EEIRP TOPIC

This section is arranged to address each of the nine technical work units for the EEIRP. Each unit provides a brief description of the interview goals, a list of the themes for that topic from the case studies, and a discussion of each theme.

Determining and Describing Environmental Significance

This topic is aimed at discovering how significant resources are identified, the reasons for identification, and examining the processes chosen to describe the impacts that a proposed project will have on existing resources. Many responses were generated for the questions in this unit. The predominant themes from the interviews are:

- The determination of environmental significance is not viewed as a difficult task; however, effectively communicating environmental significance can be a challenge.
- The North American Waterfowl Management Plan (NAWMP) was used as justification in most of the case studies as part of determining environmental significance.
- Environmental significance can take a region-specific face, which makes it challenging to compare projects from different regions.
- There needs to be more reliance on the evaluation of a project area's environmental significance by local biologists.
- Environmental significance has often been documented by other resource agencies or special interest groups prior to Corps involvement in a project.

Determination and Communication

Identifying the environmental significance of a project area generally did not require an extensive examination or the development of new tools. Most often, the environmental problem being addressed pointed to an issue responsible for degrading the historical environmental viability of an area. For example, the Galilee Salt Marsh Restoration Project in Rhode Island identified dredge material as degrading an area that historically was a salt water marsh. Additionally, salt water marshes have been recognized as a resource in decline according to the Coastal America initiatives.

The greatest challenge faced by planners, with regard to environmental significance, was successfully conveying it to project reviewers at higher levels. Although some projects have

Federal mandates and policies indicating the importance of a natural resource, selected respondents suggested project reviewers at higher levels sought additional information related to the project area to document environmental significance.

North American Waterfowl Management Plan Justification

Almost every project attributed part of its environmental significance to the NAWMP, since the project would benefit waterfowl, even if that was not its primary purpose. The NAWMP provides justification for the projects in several ways. First, it is Federal legislation that can be recognized as institutional significance under P&G. Second, it indicates areas that should be targeted for restoration.

For example, the Yolo Basin Project in California found a strong basis in the NAWMP for this project because the basin area is located in the Central Valley region of the Pacific Flyway. The Central Valley of California was designated one of seven areas vital to restoration efforts under NAWMP legislation. Ninety percent of the valley's historic wetlands were lost as a result of dam construction in the late 1950s and subsequent agricultural development. The Central Valley Habitat Joint Venture Implementation Plan calls for the restoration of 10,000 acres of wetland. The implementation of the project will restore over 3,000 acres of wetland for this region.

Regional Significance

There are many dimensions that can be considered in describing the environmental significance of a project. At times, existing conditions that cause declining habitat or water quality losses may impact species that are not endangered, but are of significance to the residents of an area. All aspects considered environmentally significant typically are documented.

Respondents expressed concern that projects with only regional significance may not get as much consideration for funding. For example, bluegill fisheries may be a significant resource to the stakeholders on the Upper Mississippi River. However, bluegill are not recognized through Federal legislation such as the Endangered Species Act. If a project designed to enhance bluegill fisheries was evaluated against another project that improved habitat for bald eagles, the eagle project would receive special attention because of the Endangered Species act alone.

Biologist Assessments

Field biologists are very aware of the conditions within a project area and their assessments should be given more consideration when determining environmental significance. The respondents from the Fern Ridge Lake Project in Oregon indicated that a local biologist should have the necessary background information to determine the environmental significance of a project. Respondents for the Homme Lake Project in North Dakota said that the determination of environmental significance is a professional judgement that can be made by field biologists.

Prior External Determination

Many of the projects examined were originally proposed or are presently operated by a local agency or interest group. The proposals were supported with information already gathered by the organizations proffering them. These proposals indicated what was significant on a local and regional level and could be used directly for statements of environmental significance in Corps proposals.

The McFaddin Ranch Project in Texas illustrates an interesting means of describing the project's environmental significance. The Texas Department of Parks and Wildlife prepared a videotape that incorporated historical data in the form of aerial photography which showed the changing conditions of the area. It was perceived by the respondents as an appropriate illustrative means of conveying environmental significance in a way all could understand.

The USFWS respondent for the Pool 8 Project in Wisconsin noted that there was a master plan for the refuge in which the island restoration took place. The respondent said the master plan could have been better utilized for defining environmental significance and that every USFWS refuge has a master plan.

Determining Objectives and Measuring Outputs

The next topic focused on clearly linking environmental significance to objectives and identifying measures for the defined objectives. The themes for this topic are:

- There is generally not a clear association among a project's environmental significance, objectives, and measurable outputs.
- There is a need for closer examination of wetland functions and their output values.
- The Habitat Evaluation Procedure (HEP) is commonly used in environmental projects. It can be used as an indicator, but not as a firm means of determining and measuring a project's outputs.
- Physical measures should be used to determine outputs until better methods are developed for assessing wildlife use of an area.

Lack of Linkages

Many respondents were unable to draw a clear connection between the environmental significance of a project and what the objectives should be to restore the project area. Many of the objectives did not have a direct correlation with what was identified as being environmentally significant. Furthermore, few projects had measurable outputs that related to the significance of the project. This lack of linkages causes confusion about what the project is attempting to accomplish.

The Fern Ridge Lake Project in Oregon was an example of the successful integration of these aspects. Significance was defined by the Fern Ridge Lake Master Plan, the Strategic Plan for Migratory Birds in the Columbia River Drainage, and the NAWMP regarding the improvement of waterfowl habitat. The objectives for the project were to increase the quantity and quality of wintering waterfowl habitat and waterfowl use days. The measurable outputs were based on waterfowl use days. This clear association between the significance of waterfowl and how outputs will be measured makes the project more understandable and illustrates how the project will address the significance of the area through project outputs.

Wetland Functions and Outputs

Many of the respondents indicated that the science of wetland management is very young and that wetland functions have not been adequately studied. As these functions are identified,

there will be a need to determine appropriate quantifications for them. This was identified as an area of concern that would have enhanced the planning process for the Mayfield Creek Project in Kentucky. Walla Walla District personnel requested information pertaining to avulsion, erosion, land loss, and energy transfers in ecosystems. This would provide them with a better understanding of the project area for formulating objectives and outputs.

Shortfalls in Predicting Outputs

HEP or similar techniques were used in eight of the projects examined. Respondents said that many of the existing biological models, such as HEP, require excessive subjectivity for making decisions. These models were viewed as not providing an accurate representation of the ecosystem and its functions. Some respondents said that the numbers generated are conservative so that it reduces the chance of project failure occurring, based on output measurement goals.

Respondents involved with the Pool 8 Island Restoration Project in Wisconsin wanted a model that would provide a system-wide view of the effects the project will have on the ecosystem. They felt that it would be difficult to develop quantifiable goals for biological outputs. The respondents said that single-species models such as HEP are too subjective for making accurate determinations about project outputs.

Many of the respondents said existing biological models are too subjective to indicate valid measurable outputs. Because environmental restoration is presently an inexact science, the models do not have undisputed reliability of determining outputs. Based on what is known of changes in physical conditions, these models can indicate the influence the project will have on an area, but not necessarily generate exact numbers for output measurements.

Respondents from the McFaddin Ranch Wetlands Project in Texas said that using a Habitat Suitability Index is a fair indicator of outputs, but cannot account for all aspects that affect an ecosystem, such as a hurricane or a drought. According to one respondent, the best measure is based on the biological opinion of field managers who have worked in the area.

Value of Physical Measures

Respondents felt that physical measurements were the best means of assessing project outputs. In general, respondents measured aspects such as stream velocity, acres of habitat, and

water quality. Respondents from the Pool 8 Project in Wisconsin strongly endorsed research for determining acceptable physical measures. These included aquatic measures, exotic plant and animal species, and other outputs that could be gauged physically or chemically.

Evaluation Of Cultural Resources

Examination of the steps (traditional or new) taken for the evaluation of a project area's cultural resources is the topic of this section. Cultural resources did not appear to have a serious effect on any of the project designs. Although some cultural resources were discovered within project areas, they were either avoided or mitigated to the satisfaction of their respective State Historical Preservation Officer. The themes of this section are:

- Present planning guidance for cultural resource evaluations appears to be adequate for meeting the needs of project planners.
- Strong working relationships should be developed with State Historic Preservation Offices (SHPO) because of the impacts they can have on a project.
- Many project areas have already been examined for cultural resources as a result of previous water resource developments in the area.
- There is a need to determine appropriate mitigation for degraded or lost cultural resources and the allocation of funding for it.

Adequate Planning Guidance

All of the respondents felt the guidance for conducting cultural resource examinations was sufficient. Non-Corps respondents were satisfied with the way the Corps was addressing this issue, and Corps planners felt the guidance provided was straightforward and easy to follow. However, it should be noted that these projects were not significantly affected by the presence of cultural resources. When a cultural resource was located, as in the Yolo Basin Project in California, the site was avoided as part of the planning process for the project area.

Coordination with State Historic Preservation Offices

Many Corps respondents said the coordinators of the cultural investigations should maintain an information flow with their SHPO from the beginning of a project to avoid any hindrances to the completion of its study. A SHPO has a significant amount of legal authority and can cause disruptions to the completion of a project. The experience at the McFaddin Ranch Wetlands Project in Texas was that a favorable rapport with the SHPO can create significant time reductions for receiving comments and for approving a project with reference to cultural resources.

Value of Prior Cultural Resources Studies

All but one of the case studies examined had been affected by a previous Corps project. The nine other projects had completed at least one cultural resources analysis for another previously constructed Corps project in the area. Quite often, researching archived data for locating potential sites of significance provides the needed information. These sites are typically avoided during the planning of the project design to prevent affecting any cultural resources.

Mitigation and Associated Funding

Difficulties can arise in completing some projects if cultural resource sites are discovered, as identified by archeological personnel from the St. Paul District. The mitigation of a former fish hatchery for a project at Bussey Lake, Minnesota, was met through the production of brochures describing the history and purposes the hatchery served, as agreed upon with the State Historic Preservation Office. Another project at the Trempeleau Refuge on the Upper Mississippi River involved protecting an island burial ground because it was being eroded by the elevated Mississippi River.

One percent of the project budget is the standard allocation for meeting the needs of cultural resource mitigation under the UMRS-EMP. In some cases this is not enough, and it was suggested that securing a waiver for additional money it is a very difficult process to endure.

Engineering Environmental Investments

This topic was aimed at examining procedures used for identifying and formulating environmental projects. The resulting themes are:

- Engineering staff at the Corps should receive enhanced environmental training and support for designing environmental projects.
- Projects should be designed to meet the original project objectives and provide flexibility to achieve them.
- Other agencies should be consulted based on expertise in a certain area, such as the Fish and Wildlife Service about projects found within their master plans or similar planning documents.
- There needs to be room for experimentation with potential new designs and structures when developing environmental projects.

Need for Environmental Training

Many engineers in the Corps have training and expertise for designing traditional Corps projects such as locks and dams, but have little or no experience in designing environmental projects. While there are many standard engineering designs for features of dam projects, very few standard designs or "cookbook" solutions are available for referencing environmental projects. Many of the design features of environmental projects are dictated by local conditions which, in some cases, limits the transferability from one site to another. However, it was suggested repeatedly in the case study interviews that a compilation of environmental project designs would provide an excellent reference and a starting point for future endeavors.

Improved dialogue between biologists and engineers would support more prudent environmental designs. The Texas Department of Parks and Wildlife conducts week-long environmental training courses, where participants spend much of their time in the field becoming familiar with the local conditions and the functions that the ecosystem serves. The respondent from Parks and Wildlife said that this training would provide much needed background knowledge for engineers designing environmental projects in the area.

Flexible and Efficient Design

Building environmental projects to meet the originally intended objectives is a two-edged sword. On one hand, it provides the advantage of binding the stakeholders involved (e.g., interest groups, local sponsor, the Corps) to the project in a way all can understand to advance the planning process. On the other hand, because environmental projects are characterized by a great deal of discovery after the process is initiated, original objectives and project features must be flexible. The challenge here could be as much an issue of objective formulation than of engineering design. Clearly, though, if objectives must change for the overall betterment of the project, careful attention should be given to identifying and managing the adverse effects.

Cost problems usually arise when the project is excessively designed or "overengineered." The Corps traditional focus has been to ensure engineering success and withstand extreme events. This can be counterproductive as well as costly for environmental projects. An example was at the Galilee Salt Marsh Restoration Project in Rhode Island where the Corps recommendation for culvert size was significantly larger than that identified at another nearby non-Corps project serving the same purpose. The local sponsor's concern was that the total project cost and its cost-share were being increased significantly. While the original objective of introducing saline water into the marsh was being met, it was being overaccomodated, thus causing the perception of unnecessary cost increases.

Consultation with Experienced Agencies

Expertise on engineering design for environmental projects is available in Federal and state agencies, as well as industry. These groups are willing to contribute expertise to the Corps in the design process. In the case of state agencies, they have been mandated to manage environmental areas and they have developed a thorough understanding of local environmental conditions. Typically, they have successfully engineered projects in their own state. Federal agencies, such as the U.S. Fish and Wildlife Service, have decades of expertise and trained professionals in the area of environmental management.

Several agencies have provided design information that was useful in the completion of project designs for Corps environmental projects. As the need for environmentally sensitive flood control measures emerged in Mayfield Creek, Kentucky, the Corps was able to successfully draw upon the American Fisheries Society's Stream Obstruction Removal Guidelines. For the Homme Lake Project, the North Dakota Department of Game and Fish

provided unique information regarding the use of culverts to provide nesting habitat for waterfowl. Corps engineers involved with the McFaddin Ranch Wetland Project in Texas modified a water control structure design from the Soil Conservation Service office in Louisiana.

Experiment with New Designs

Traditionally, the Corps designs projects that have a known certainty of success based on past experience. As mentioned earlier, there are many unknown factors and approaches to meeting the goals of environmental projects. Respondents in several case studies indicated a need for allowing experimentation with alternatives during the feasibility study stage. Experimentation in the field was said to be preferred over waiting for tested designs to be put in place. The testing process can sometimes take years, and the concern was, in some cases, that environmental conditions would significantly worsen while waiting for a design.

Part of the planning process for the Kissimmee River Restoration Project in Florida was the construction of a test plug to see how it would perform in the existing conditions. Respondents from the Jackson Hole project in Wyoming were anticipating approval for testing in-water structures to determine their effects on the fast-moving Snake River.

Monetary And Other Valuation Techniques

This topic was directed at examining how value was assigned to environmental projects. In addition to monetary valuation, techniques focusing on ecological outputs and nonmarket approaches were examined. The responses to these questions were diversified and lengthy in some cases. However, several similar themes appeared during the analysis of the data. These themes are:

- Emphasis should be shifted from monetary techniques toward nonmonetary values and qualitative information when studies are evaluated.
- Most projects include increases in habitat units as part of the value of the project.
- Local respondents feel that recreational and educational values should be included as part of project benefits.

- Many of the benefits have been determined prior to the feasibility study through a previously developed plan, or as part of a national program.

- Project benefits are selected based on what planners perceive as required by the reviewers in Washington.

Qualify Nonmonetary Benefits

Only two of the projects actively examined monetary benefits; the other eight did not conduct an analysis because it was not required. Respondents for all ten case studies recognized the importance of including monetary benefits. However, there was a general consensus that benefits without defined economic values were either overlooked or viewed less favorably during the evaluation of project proposals.

Many benefits of environmental projects do not have a monetary value acceptable to all agencies. Qualitative remarks were seen as necessary to convey special benefits because each project is unique in what is being constructed and in its location. For example, the project in Jackson Hole, Wyoming, is to reduce stream velocity and restore riparian habitat, which provides benefits for various freshwater species of plants and animals, as well as people. The Galilee Salt Marsh Restoration Project in Rhode Island is to restore a saltwater marsh which will provide benefits for saltwater species of plants and animals. Each project will provide considerably different types of benefits based on habitat alone, and respondents felt these benefits should receive more qualitative descriptions.

Value of Habitat Units

Every project examined the change in habitat type, whether it was strictly on an acre-by-acre conversion rate or with a habitat-based indicator model. Respondents' comments reflected that this is an essential part of describing a project's benefits. Reservation was expressed toward using this information as a means of comparison if projects are competing against each other for funding. If the amount of acres restored is chosen as a category for selection criteria, it may overlook a smaller project that would restore a habitat in severe decline. If selection criteria is based on a habitat indicator model, the results could be skewed because of the subjectivity involved in its application.

The McFaddin Ranch Project in Texas applied a habitat suitability index (HSI) using a model for the mottled duck. The existing HSI was determined to be 0.36 and the project would raise the HSI to 0.79. This index shows the project should more than double the existing habitat quality for the mottled duck. A dilemma arises if this project is compared with the one at Homme Lake in North Dakota, where the HSI for the wood duck was 0.10 without the project and 0.60 after its completion. The Homme Lake Project increase is five-fold, but it does not achieve the level of the McFaddin Project. If comparisons are done, a further question to consider is whether or not a mottled duck HSI should be compared to a wood duck HSI.

Local Education and Recreational Benefits

Local respondents from each case study, as well as some other participants, strongly advocated the inclusion of education and recreation benefits in project formulation. The Yolo Basin Project in California was incorporating an educational center as part of the project. The value perceived by local residents helped to generate significant support for the project. Respondents said these types of benefits do not have an economic value, but feel that a qualitative description of its educational value was appropriate.

Nearly all respondents suggested that recreation benefits should be an immediate consideration of all environmental projects. A link was perceived between restoration of the environment and the recreation that can be derived from it. Among Corps respondents, it was unclear whether recreation benefits should be emphasized given changing Corps mission emphasis and authority. Some respondents suggested cautious promotion of recreation benefits, indicating that it might hamper restoration efforts. Recreation features are not always aligned with environmental restoration. For example, the Pool 8 Project in Wisconsin constructed islands to provide nesting and rearing habitat for waterfowl. The USFWS felt that if recreation benefits were promoted for the project, people would be boating to the islands and disrupting nesting periods, thereby reducing the amount of waterfowl that would survive.

Associated Benefit Credits

All of the projects have been able to derive a significant line of benefits from broader plans or programs they were supporting. The benefit categories often are expressed through legislation or in the wording of goal statements. The NAWMP was referenced in almost all of the ten case studies. Other such programs referenced included the Coastal America Project, the

Coastal Wetland Planning, Protection, and Restoration Act (CWPPRA), the UMRS-EMP, and the Fern Ridge Lake Master Plan.

The Fern Ridge Lake Project in Oregon was part of a long-range planning effort for an entire region. The master plan indicated that this project should provide a 200,000-day increase per year of waterfowl use days for the area. In conjunction with its master plan, additional benefits for waterfowl were drawn from the NAWMP goals for that region. The existence of this information made it easier for the Corps to develop the benefit parameters for this project.

"Washington-Driven" Benefits

One issue evident from the responses of the participants was that the selection of benefits was based on what was perceived as soliciting the approval of the project from reviewers at the Washington level. Although there were many benefits to select, all the respondents felt as if they were required to focus on what the reviewers were seeking as opposed to what benefits the project could provide. An example is the perception of the inclusion or exclusion of recreation benefits as a means of justifying a project. Wetland acres was referenced as an appropriate choice for benefit categories, which is in line with the Corps attention to wetland areas and mitigation.

Cost Effectiveness/Incremental Analysis

Responses to incremental analysis were varied and numerous. Respondents expressed strong opinions about the role of cost effectiveness regarding environmental projects. The resulting themes were:

- Incremental analysis is a useful tool for the planning process, but it should be recognized as one of many elements in the final decision.
- There is significant difficulty in applying incremental analysis with regard to determining appropriate components for conducting an analysis and the level of analysis to be conducted for small-sized projects.
- Communicating the results of incremental analysis can be difficult, especially to individuals representing local interests.

One of Many Planning Tools

Respondents saw incremental analysis as a useful tool for planning environmental projects, but felt that reviewers at higher levels relied too heavily on the information generated by the analysis as criteria for approving projects. Most groups that conducted an incremental analysis on alternatives said examining the results requires the recognition that assumptions are made about some of the outputs factored into the calculations. The results of the analysis could be altered significantly if the assumptions made are incorrect.

Some of the respondents from the Pool 8 Project in Wisconsin were concerned about placing a heavy emphasis on cost effectiveness for project justification because some of the benefits of environmental projects are not quantifiable. If the benefits can be quantified, they are not accepted by all agencies throughout the United States. For example, depending on the type of model being used for assessing habitat, fisheries could be rated as more valuable than wildlife habitat or vice versa. This inconsistency does not provide an equitable base for selection among projects if they are in competition for funding.

The analysis conducted for the Kissimmee River Project in Florida examined the cost effectiveness of the project based on how many miles of dredged channel should be backfilled. Consideration was given to the average annual habitat units that would be provided versus the cost of the backfilling a certain amount of miles. This information provides a fair comparison because all calculations are subject to similar assumptions regarding restoration of habitat units, and if those assumptions are incorrect, all the results should be affected equally.

Selection of Variables for Incremental Analysis

The variables selected by respondents who conducted incremental analysis were based on an educated guess of what would be accepted by reviewers. There was no set approach to follow, and often some measurement of habitat was part of the analysis. As indicated earlier, there was some trepidation toward the validity of the outputs incorporated into the analysis and their accuracy. This apprehension was further amplified by biologists when biological outputs that relied on subjective judgements were incorporated into an analysis. Respondents from the Fern Ridge Lake Project in Oregon indicated there was difficulty in selecting appropriate increments for analysis. They selected the option of waterfowl use days provided per constructed impoundment. The Portland District biologist was recognized as playing a

significant role in defining the biological outputs the project would provide. It was noted that output results are based on a best estimate of project success in providing waterfowl habitat.

Another concern was the amount of analysis to be conducted for mitigation projects or projects that are small in size. Some respondents in restoration projects such as Galilee Salt Marsh Restoration Project in Rhode Island saw incremental analysis as a means for reducing the amount of restoration to be done based on cost effectiveness. For smaller projects, such as Homme Lake, North Dakota, respondents indicated that the alternative is obvious and that expending resources to develop others is imprudent.

The incremental analysis for the McFaddin Ranch Wetlands Project in Texas was based on the habitat suitability index for the mottled duck regarding each alternative. Galveston District respondents said incremental analysis assumes there is a wide array of options to examine, but for mitigation projects, these options are limited.

Communicating the Results

Some respondents said that communicating the results of incremental analysis to local representatives was not an easy task. There are some technical issues that sometimes are not understood by the local sponsor or other local interest groups. Representatives of the Memphis District and Lower Mississippi Valley Division determined cost effectiveness for the Mayfield Creek project in Kentucky using NED accounting techniques to calculate a benefit/cost ratio. Using incremental analysis was perceived as a cumbersome process, and results were difficult to explain to locals. They also said that using the Stream Obstruction Removal Guidelines is an all-or-nothing alternative. Either all the obstructions are removed or the project will not achieve success.

The Galilee Salt Marsh Restoration Project in Rhode Island, provides another example of how the results are interpreted by a local sponsor. The respondent from the Rhode Island Department of Environmental Management said the results of the incremental analysis were impressive. However, the results were very confusing when the respondent tried to interpret their meaning.

Determining Risk And Uncertainty

This section presents responses and issues raised to the topic of employing risk and uncertainty analyses in the plan formulation process for environmental projects. Formal risk analysis was not conducted for any of the case studies, though it was mentioned as a concept considered informally. The themes were:

- Risk assessments are made informally when considering engineering options.
- Conducting formal risk analysis was not viewed as feasible because of the lack of data regarding environmental projects, construction methods, and associated outputs.
- Environmental projects are not constructed to reduce a threat to human life and property, therefore, the risk of failure is more tolerable if it reduces the overall cost of the project.

Informal Consideration

In most cases, important elements of the project were examined and an informal risk assessment of what it would take to make the elements functional was conducted. Where the analysis stops is the examination of probability distributions that describe the engineering success at each element, which would lead to stringing together the probability distribution of several elements, thereby providing a more redundant analysis of risk. Most of the respondents were comfortable making the needed engineering judgements without formal risk analysis. It should also be noted that very few of the Corps respondents were apprehensive about employing risk concepts, which suggests that they were generally familiar with the standard techniques.

An example of the informal consideration of risk is the La Branche Project in Louisiana and other CWPPRA projects. Each project proposed is evaluated according to general parameters, one of which is the feasibility of the project design and how it meets the set of environmental objectives.

Lack of Historical Data

Many of the respondents did not feel that risk analysis would provide viable results because very few environmental projects have been completed. Conducting risk analysis without data from other projects to compare against was perceived as inefficient. Respondents felt that doing so would have created an unnecessary addition to the cost of the project.

Limited Impacts on Human Life and Property

The original impetus behind most of the environmental projects is the restoration of habitat. The project in Jackson Hole, Wyoming, may present some risk to the public property if there is a failure, but it is contingent on how water is placed behind the levees to restore riparian habitat. Most of the restoration projects were located in extremely rural areas with low populations. Flooding has the most potential for causing damage in these projects, and it has been examined for every project. Island restoration for the Pool 8 Project on the Mississippi River was temporarily stopped until it could be proved to the state of Wisconsin that the project would not affect the existing flood protection. Respondents viewed this consideration as part of the normal process and not worthy of additional risk analysis.

As mentioned previously, there is a great deal that is unknown in the development of environmental projects. Planners are still trying to establish relationships between what is constructed for environmental projects and what the outputs will be. Many respondents said there is a need for engineers to accept a certain amount of failure in project designs because there is a high level of uncertainty regarding project effects on ecosystems. This uncertainty was perceived as the reason for not pursuing risk analysis, since it would inflate project costs and generate questionable data.

The interview respondents, in all the case studies except for Jackson Hole, Wyoming, said there is not a threat to the public if these projects fail. The greatest threat is to the resident wildlife of the current habitat that is being restored to historical conditions. Until relationships are developed showing project effects on the ecosystem, designs need to involve risk taking, not risk avoidance.

Developing And Integrating Environmental Databases

This section focused on the development of special databases, or the creation of database linkages to support the analysis. All respondents placed a high value on having access to quality data for project planning. The resulting themes were:

- Topography, land use, and water quality data are typically available for the study area, as are environmental data from the Environmental Impact Statement (EIS)/Environmental Assessment (EA).
- Needed data should be managed centrally and be made more accessible by computer modem.
- There is a need for long-term monitoring of environmental projects to determine success and to gather data that can be used by others for future environmental projects.
- Databases should be compiled for environmental engineering designs and available evaluation methods.
- The use of a Geographic Information System (GIS) in the planning of environmental projects brought mixed results, dependent on how extensively a GIS was used within a District.

Common Data Types and Sources

In every case study, basic maps were available that described land use, topography, and water boundaries in the study areas. If significant changes in recent times had occurred, updates to this information were obtained typically through new surveys or other field techniques. USGS data on water flows from gauging stations are readily available and utilized.

Detailed vegetation data are typically gathered for the development of HEP models or other habitat analyses. These data are collected or updated mostly by the entity conducting the HEP, which in many cases is the U.S. Fish and Wildlife Service.

Significant amounts of environmental data are collected during the EIS or EA process. An accounting of project impacts on existing environmental resources must be conducted, requiring detailed inventories of plant and animal species in the study area.

Several projects examined during the case studies made use of local colleges and universities, contracting with them to conduct monitoring or to develop models for using data that have been gathered. The planning of the Galilee Salt Marsh Restoration Project in Rhode Island drew upon the expertise of the University of Rhode Island to conduct monitoring of the project area and to develop data incorporated into a GIS map. The La Branche Project in Louisiana incorporated numbers of academic experts from the state as part of the study team. Modeling information for the Kissimmee River was developed by the University of California at Davis.

Respondents that utilized local college and university resources indicated a careful examination of the school should be done to make sure they have the expertise and resources to meet study needs. In the case of the University of Rhode Island, its biology department had been conducting a significant number of marsh studies in the area for several years. Because of their familiarity with the project area, university personnel were perceived as an asset to the planning process.

Automated Data Clearinghouse

Respondents wanted to have a means of accessing data for planning environmental projects by computer modem. All types of information were requested, including engineering concepts and designs, information from experts in the field, and ecosystem data. More than one respondent suggested that the Corps would be an effective candidate as a clearinghouse for an environmental database, some more specifically indicating the Waterways Experiment Station as a viable location. This concept would not only require a sponsor, but would need careful design so that contributions of data could be made efficiently. A process would have to be put in place to encourage the participation of other agencies.

Long-Term Monitoring Programs

All respondents indicated the need to monitor the impacts of environmental projects to compile data that would assist with future planning efforts. These data could be used to

empirically enhance models so a better understanding of environmental management actions will be realized. Respondents said that it may take as long as ten years before the full benefits of environmental projects are realized. In some cases, the alternatives used are new, and long-term monitoring should be conducted to determine what effects the project has on the overall ecosystem.

Respondents from the Pool 8 Island Restoration Project in Wisconsin were extremely pleased to have a long-term monitoring program in place as part of the UMRS-EMP. Respondents said that the information gathered will be used for future projects constructed on the Upper Mississippi River System.

Engineering Design Databases

Engineer respondents said that it would be helpful for them to have a means of accessing other agencies and organizations to see what designs have been applied in past environmental projects. Even if the designs did not meet the goals of the project, it would provide some new approaches regarding environmental engineering concepts.

In several cases, the respondents attributed good fortune to the discovery of some of their designs based on meeting the right people at the right time. The culvert nesting design for the Homme Lake Project in North Dakota came from a member of the North Dakota Department of Game and Fish who discovered this unique approach. If that person was not a part of the project, the implemented design would never have been considered because such information is difficult to access. Respondents felt that there are others throughout the United States who could provide important information that would make a significant contribution to environmental project planning.

Geographic Information Systems (GIS)

Six of the case studies had incorporated some form of GIS into the planning process; however, there were mixed responses to its effects. Many found the maps created by the GIS provided a format for presenting information in a manner all could understand. The difficulties that arose were the result of the expenses of its use. In the case of the St. Paul District, its GIS is used for a number of projects in the region, primarily for the Upper Mississippi River.

Although the initial start-up for a GIS is somewhat costly, its extensive use for numerous projects justifies its existence in the St. Paul District.

The Jackson Hole Project in Wyoming first developed a GIS map through the University of Idaho. The map was going to be color coded with the assistance of an artist. When it was taken over for completion by the Walla Walla District, the actual cost of producing the map increased significantly. Although an attractive map was produced, there was not enough data from the project area to be entered into the GIS for further usage. Future GIS applications for the project were not seen as likely because the cost of gathering data would put an undue burden on the cost-sharing local sponsor.

Evaluation Framework

This topic was directed at describing how the final project design was determined and how differing perspectives were managed. The resulting themes are:

- The Districts would like more autonomy for making field decisions that are based on an area's environmental attributes.
- Most project alternatives selected for implementation are chosen based upon informal negotiations directed at meeting environmental goals versus formal trade-off analysis.
- Many wetland enhancement project alternatives are tempered so they will not compromise the flood protection of a study area.
- Financial constraints of local sponsors limit potential project alternatives, as well as the sponsors' involvement, enthusiasm, and flexibility for the project.
- Projects should be evaluated as part of a system instead of an isolated area.
- Multiagency teams need to be assembled at the beginning of the planning process, and should continue to meet at important junctures throughout the project.
- Positive media coverage at the start of a study provides significant public support for environmental projects.

- Demonstration projects and in-field experimentation with alternatives provides significant public support for environmental projects.

Streamline the Review Process

District respondents were frustrated with the review process regarding field decisions. Because environmental restoration is an inexact science, there are some parts of the planning process that are determined by scientific conjecture. Districts are continually responding to decisions that fall within this realm, such as project outputs. In the Fern Ridge Lake Case Study in Oregon, the District biologist said there were numerous requests for additional output information from higher levels. There were significant resource expenditures in trying to meet these requirements and it appeared to only result in requests for more data. It was thought by District respondents that this only lengthened the review process and caused anxiety by others wanting to see the project completed.

Another reason District respondents would like authorization for making field decisions is for the satisfaction of local sponsors and residents. The longer it took to receive authorization for a segment of the planning process, the more restless and frustrated locals became with the development of the project. Two primary concerns of locals were the accelerated loss of habitat and the possibility of increases in project costs. Local respondents in the Jackson Hole Case Study in Wyoming shared these concerns, fearing lengthy delays in restoring the Snake River would prevent a proposed alternative from being implemented and possibly prevent any restoration. One example is that some parts of the Snake River have become "bulletproof," meaning the bottom has been stripped of all vegetation and is extremely hard. There is currently no known way to restore a river bottom in this condition.

Several Corps respondents said there is a need to have more informal review during the development of feasibility reports. It was thought that more informal review of documentation familiarizes reviewers with the project and circumvents the need to conduct additional analysis after the report is written. Unofficial drafts should be exchanged and frequent telephone calls should be made to limit surprises and expeditiously achieve completion of the feasibility study. Having Division and Headquarters reviewers at the project site to see firsthand the physical constraints and features of the study area would be very beneficial to the review process.

The Memphis District and the Lower Mississippi Valley Division worked jointly on the Mayfield Creek project in Kentucky, and this was viewed as helpful in developing the planning of the project because of the reduction of time related to review difficulties. The North Pacific

Division indicated it was working to promote more informal interaction with the Walla Walla District on the Jackson Hole Project in Wyoming project to improve the review process. The North Central Division echoed this sentiment saying that informal interaction should occur throughout the Corps.

Informal Negotiations

The chief decision criteria in the evaluation process was whether the partners involved perceived the project as meeting the intended reason or purpose for environmental enhancement. Trade-off analysis or arbitration to arrive at a consensus on the final project alternative were formally employed in very few cases. This is not to say that there were not opposing views in the planning process. Rather, consensus was arrived through informal negotiations and due process versus utilizing formal dispute-resolution techniques.

Most of the case studies that were examined presented straightforward problems that required the development of individualized designs. In the case of the Mayfield Creek Project in Kentucky, the project design was to be environmentally-oriented, yet provide improved flood control and drainage. The resultant design, which employed Stream Obstruction Removal Guidelines, met the goals of the project. Projects that were developed from a master plan had potential designs available, reducing needs for evaluation. In the case of the Fern Ridge Lake Project in Oregon, the master plan called for the creation of impoundments. Additional alternatives were developed from variations of the design put forth in the master plan.

Flood Protection Maintenance

Many of the case studies examined were built in areas which originally implemented flood control projects. Although the goal of many wetland restoration projects is the maintenance or increase of wetland acres, many have to be concerned with not affecting original flood control goals. Before the Pool 8 Island Restoration Project could proceed, special permits had to be secured from the state of Wisconsin because of its flood control laws that prohibit the placement of any material in the Mississippi River. If the permits were not approved, the project may not have been constructed.

In addition to normal flood protection goals, some environmental projects must avoid flooding because some habitat types cannot be underwater for extended durations. The Jackson

Hole Project in Wyoming is attempting to determine a way to return water to the riparian areas behind the levees in a way that will not drown the flora, and also not negatively impact landowners' property. In the case of the Yolo Basin Project in California, some of the ponded areas will be drained as a form of mosquito abatement.

Cost-Sharing Limitations

Some elaborate or intensive designs are not able to be implemented based on the financial constraints of the local sponsor. Often state agencies or local governments are the local sponsor for cost sharing purposes. The sponsor's budgets are extremely limited, and cannot expand to accommodate more costly methods. The North Dakota Department of Game and Fish contributed $ 9,150 for the Homme Lake Project, which was the amount needed to meet the twenty-five percent cost-sharing requirement. It was noted by all planning partners that this amount was a significant percentage of the North Dakota Department of Game and Fish's operating budget. In the case of the Jackson Hole Project in Wyoming, the County Commissioners have opposed some proposals to the feasibility study because the additional costs would exceed their ability to meet the cost-sharing requirements.

Local sponsors indicated that the money they budget for a project is usually the maximum amount available for cost-sharing in a project. Additional costs that may be added during the study process could cause the sponsor to fight the adjustments made to the project or become unable to participate in the cost-sharing of the project. The only project where cost increases were prohibited was the La Branche Project in Louisiana as directed by the CWPPRA. In that project, design alternatives had a definitive budget that could not be exceeded.

Total System Analysis

Several respondents suggested that projects should be examined as part of an overall system within a region. Many referred to it as a watershed approach, which better characterizes the impacts of management practices in the region. Examining a project in isolation often gives a short-sighted view of the environmental impacts and can even lead to less than optimal decisions. Evaluation and management of the entire watershed will aid in highlighting the critical environmental problems in the area and will facilitate data exchange. The projects for the Kissimmee River in Florida and Pool 8 in Wisconsin have long-term monitoring in place, and that aspect was considered to be very important in the planning of these projects.

Multiagency Teams

Projects characterized by actively engaged interagency groups or task forces were viewed as very effective from the perspectives of those interviewed. Decisions made at important junctures of the planning process were made cooperatively, keeping everyone informed. Negotiations of political and technical subjects were communicated by the task force to their respective agencies. In several cases, the Corps was seen as the leader of the interagency group and took the coordinating responsibility.

Nearly everyone interviewed indicated that a strong interagency working group active from the beginning and throughout the planning process is very much a part of its success. This was even recognized by those who said their subject project did not have an active task force. Respondents indicated that the initial exclusion of some agencies responsible for issuing permits could create delays in completing the project approval process.

Recommendations were made indicating that groups should meet regularly, and that accurate notes of the meetings should be kept to inform personnel who are replacing someone else from their agency. In many instances, turnover of key personnel in these groups was noted as a significant problem because bringing new group members up to speed consumed valuable time during the study process. Accurate meeting notes and a robust system of checks and balances would limit the effects of personnel turnover.

Positive Media Involvement

Proper and strategic use of media coverage should not be underestimated. The Corps public affairs office should be consulted to ensure that basic public relations protocol and opportunities are used. Agencies and organizations constituting the planning committee for the proposed environmental project are representing some facet of the public. Anything that can be done to prevent the process from becoming confrontational will aid in smooth interagency progress toward project completion.

Respondents from the Yolo Basin Wetlands Restoration Project in California and the La Branche Project in Louisiana both indicated the significance of media coverage. In the case of Yolo Basin, the respondent from the Yolo Basin Foundation said that better media coverage would have helped to move the project along faster by generating more public support. For La

Branche, the project was used as a demonstration project for the CWPPRA legislation and it provided significant public support to aid in its advancement.

Indirectly, the Pool 8 Project in Wisconsin illustrates why media coverage can be important to the planning process. Respondents indicated that residents were not well informed about the project prior to the public meetings, and because they were not well appraised of the situation and what was to be done, it was difficult to keep them focused. Because the residents had no way of learning what the meeting was discussing, it became difficult to convey the information to the public.

Respondents from the Jackson Hole Project in Wyoming said that local people were anxious to see something done in the area. The Walla Walla District received positive media coverage when it began the reconnaissance study. Some of the local respondents said they were pleased the Corps was pursuing the project, but felt that some physical changes to the area should be taking place as part of the study process.

Value of Physical On-Site Progress

Respondents indicated that local sponsors and residents of an area like to see evidence of physical progress during the feasibility study. Respondents in all case studies said local support and enthusiasm for a project is maintained as long as something is being done on site. If the planning process lasts for an extended period of time, locals become restless and unhappy with the progress of the project. The respondents for the La Branche Project in Louisiana said they gained significant public support because they were able to move quickly, and, in a way, it served as a demonstration project for the CWPPRA. It was thought that if the planning process took any longer than what actually passed, the public would have responded negatively.

PARTNERS PLANNING PERSPECTIVES

Evolution of a project plan rests on the shoulders of the participating agencies and interest groups. The previous section presented the perspectives of these participants in terms of the critical elements of the environmental plan formulation process (which correspond with the EEIRP work units). This next section provides an alternative but complementary facet, examining the major planning issues from the perspective of each partner. Better understanding of the needs and challenges faced by the individual partners will aid in the development and

maintenance of a strong interagency group—this group being responsible for the evaluation process.

The partner categories for this section are based on the groups encountered during the interview. These categories are Corps Districts, Corps Divisions, Corps Headquarters, local sponsors, other Federal agencies, state agencies, and special interest groups. The first paragraph of each section describes the general role of the partner in the environmental planning process. The subsequent discussion highlights the perspectives of the individual partners in terms of technical challenges, environmental policy, and communication.

Corps Districts

The Districts in most cases provide the anchor around which the planning process takes place. It must coordinate between all of the partners involved in the planning process and develop an alternative that is acceptable to all. Because the case studies in this research were Corps-sponsored projects, the District was the official project representative in the field. The District was faced with meeting the needs of HQUSACE and Division, as well as addressing the issues that arose from the local partners. The District acts as a clearinghouse for technical and political information. Some of the partners were able to provide significant technical support to a project, which was a great asset to District planners.

District respondents indicated that the greatest challenge they encountered is determining appropriate measurements for environmental projects. The difficulty came in developing output measures that would be acceptable to reviewers at higher levels as well as local partners involved in the planning of the projects. Many District planners recognized that they were new to the field of environmental planning and they were not aware of any globally-accepted models that measure and forecast biological/environmental outputs. Although this view was shared with non-Corps partners, District respondents suggested the technical short-comings caused inefficiencies and confusion in the evaluation process.

Recognition was given to the value of utilizing biological personnel in the planning process. The Portland District said involving a staff biologist at all levels of planning helped to provide a project that was functional and designed with minimal difficulty. The biologist's expertise was seen as a safeguard against any changes in the project that would reduce its environmental effectiveness. Projects that used a biologist as study manager were perceived as mixed blessings. Difficulties arose with respect to managing the study because the biologists' background did not prepare them for the planning challenges they faced. The positive aspect

was the attentiveness to the biological aspects of the project and making certain those concerns were addressed.

District respondents were concerned that during the review process some types of information were receiving either too much or too little consideration. One example was incremental analysis. Incremental analysis provides utility to planners during feasibility studies, but respondents felt that most reviewers at higher levels perceived analysis results as the most valuable information to evaluate a project. District personnel were not confident that incremental analysis or the data used were reliable because of the uncertainty of environmental responses to implemented alternatives. Most indicated that the information generated by incremental analysis needs to be examined in the context of the other data and assessments contained in the feasibility study.

Many District respondents requested more autonomy in the planning process. Most encountered difficulty in receiving approval from higher levels in matters regarding the coordination of an interagency committee or selecting an alternative habitat assessment method. Many of the needed decisions were influenced by the region where the project was located. District personnel often felt they were best equipped to address some of these issues because of their familiarity with the region, and that receiving approval from higher levels was creating an unnecessary inefficiency in the planning process. Many District respondents said that the local sponsor, as well as the other partner agencies, maintained close coordination in making sure inefficient choices were not made.

Corps Divisions

Divisions played a wide variety of roles in planning environmental projects. Some worked concurrently with the District throughout the planning process. Others functioned as a point along the review process. In any case, Division respondents perceived their communications with District offices as adequate, but recognized improvements in the planning process could be created through more informal interaction.

Division respondents felt the most important challenge they faced was obtaining the authority to authorize environmental projects whose total costs were below $2 millon. The only region where this power was granted was due to special legislation. Projects outside of this authority still require approval from HQUSACE. Several of the Division respondents said they were drafting proposals to HQUSACE requesting approval power based on the fact that some of the projects require immediate attention to prevent extensive degradation of an area. Division

respondents perceived many of the delays being attributed to the reviewers' unfamiliarity with the region of the project being examined.

Another concern of Division personnel was training environmental personnel to manage environmental projects. Personnel with biological expertise were perceived as an asset to directing environmental planning, but Division personnel recognized that they were often not adequately prepared to effectively manage such projects. Efficiencies were realized in some aspects of projects where biologists led the studies, but Division respondents felt with additional management training, personnel with biological expertise would be better-suited to lead future environmental projects.

Corps Headquarters

Personnel at HQUSACE are responsible for developing policy as well as reviewing and approving plans for environmental restoration efforts. HQUSACE is the most prominent rung of the review ladder because, in most cases, it must distribute financial resources among a wide variety of projects. The mode of distributing resources is very much tied to the political pressures from Congress.

There are many criteria considered by HQUSACE in the evaluation of proposed projects. The most important criteria suggested by the HQUSACE workshop participants (see Appendix A in Volume II for full explanation of workshop activities), were Corps linkage, biological feasibility of the project, and thorough formulation of alternatives.

The first major issue of concern to HQUSACE is whether the project is in the Federal interest, and whether there is linkage between the environmental challenge and the Corps mission. This criteria is mainly supported by a clear statement of the problem. This may require a visit to the site by HQUSACE.

Biological feasibility criteria lead to the more general question of: Is this project going to work? This line of questioning is warranted for reviewers and the agency ultimately responsible for the project's success. A wide range of information is sought to support the notion of biological feasibility. A clear tie to measurable outputs was suggested as most important. Another very important source for determining biological feasibility is through other resource agencies and interest groups.

Creation of a set of project alternatives is a key indicator of a strong planning effort. HQUSACE looks for a thorough evaluation of project alternatives followed by a clear justification of the recommended plan relative to the other alternatives. Critical information in the development of alternatives defines significant outputs and benefit categories (both monetary and nonmonetary). The HQUSACE respondents noted that the important information needed to support the formulation of alternatives criteria in the workshop is not readily available. Thus, it was clear to them that some effort is needed in terms of research and guidance to meet the formulation of alternatives criteria.

It was recognized that different reviewers have different areas of expertise, thus affecting what the review emphasis will be. The attention to biological aspects would receive greater emphasis by a biologist as opposed to an economist or an engineer. If time and resources allow, review from all relevant disciplines should be conducted.

Interaction Within The Corps Hierarchy

The relationships among District, Division, and HQUSACE in developing environmental project plans can be described as functional, though sometimes strained. Several times during the interview process it was suggested that Corps higher levels simply slowed the process down. The HQUSACE perspective is that the Corps is only going to spend funds where needed. The best way HQUSACE knows how to ensure good project selection is through rigorous planning involving the creation of project alternatives and analysis.

A very real factor in the intra-Corps operation is the political differential. HQUSACE is directly responsible for supporting Administration policy and strategies. The Corps also has to support the political positions of different regions across the U.S., which are highly variable when it comes to environmental issues. These regional perspectives are typically faced by the Districts.

In the midst of the twisted political situation surrounding environmental projects, there is some common ground regarding the respective planning concerns of HQUSACE and the Districts. There is documentation of linkage which HQUSACE considers to be important information in a feasibility report. The Districts have suggested that documenting environmental significance, which is tied directly to linkage, is a requirement that they feel equipped to accommodate. In turn, HQUSACE feels that, for the most part, the approach taken by the District is adequate.

All the levels within the Corps agree that biological feasibility is a critical component of an environmental plan. Until biological feasibility and the tie to project outputs is advanced technically, this important component will remain clouded. Districts, Divisions, and HQUSACE all suggested more research in the area of biological feasibility and measurement of outputs.

Development of project alternatives is considered critical by HQUSACE in putting together and justifying an optimal environmental project. Most District planners would agree with the intent of examining several alternatives. But the problem arises when more than one logical or realistic alternative is simply not available. District planners sometimes develop alternatives solely for the purpose of meeting HQUSACE requirement for multiple alternatives. This appears to miss the intent of approaching good planning, as well as being a waste of planners' resources. The District has suggested flexibility in the development of alternatives and associated analysis (e.g., incremental analysis) if no other logical alternative exists.

There is one last note of comparison between Districts and HQUSACE. Several Districts indicated the great efficiency gains when HQUSACE visited the site. It gave the District staff opportunities to discuss the details of the proposed plan, using maps and visits to the actual site. An additional secondary benefit was that HQUSACE had an opportunity to better understand some of the local political issues. The merits of ground-truthing and site visits were also highly proclaimed by the HQUSACE participants at the workshop.

Local Sponsors

The local sponsors provide the needed resources for meeting the requirements of cost-sharing agreements. In many cases, the local sponsor was the originator of the project. Local sponsors included county governments, Federal and state conservation agencies, and water management districts. Each sponsor brought varying amounts of expertise to their respective projects, and all were committed to completing the project.

The most prominent comment from the local sponsors was the need to place a greater emphasis on the qualitative information generated for feasibility studies. Respondents recognized that reviewers may not be aware of an area's significance to the local population, in addition to benefits that are not easily quantified. The qualitative information was perceived as a means to provide a story that would supplement traditional numerical demographic data, and one that was easier to comprehend.

Concern was expressed by several local sponsors regarding the potential of compromising existing projects or overengineering alternatives. In the case of compromising existing projects, several of the proposed projects were to be built in regions that implemented flood control measures. Although local sponsors wanted the environmental projects constructed, they did not want to lose the benefits of current flood protection.

The issue of overengineering was related primarily to local sponsor's fears of cost overruns and inefficiencies. All local sponsors wanted the final cost of the project to match the projected costs because of budgetary constraints. In some cases, sponsors were concerned that too much was being done to solve the problem. For example, the local sponsor in the Galilee Salt Marsh Restoration Project in Rhode Island raised concerns that the culverts being used may be excessively large and that smaller, less expensive culverts could be installed instead.

One final predominant issue voiced by local sponsors was the need for engineers to receive environmental training. Several of the case studies provide examples where the sponsor indicated the needed biological features, but the engineers struggled with some of the concepts because they did not have an understanding of biological functions. Sponsors felt that with better training, design issues could be resolved sooner and with less difficulty.

Other Federal and State Agencies

In most cases, Federal and state agencies not acting as local sponsors played supporting roles in the planning process. Many provided data regarding habitat surveys and species counts. Some were able to provide alternatives or helpful suggestions for the project design. In many instances, it could be said that these agencies represented the interests of the animal species and habitats.

The most common suggestion made by Federal and state agencies was the need for the formation of active interagency teams for the planning process. The stakeholders on the team should be identified immediately and they should be involved with the project until construction is complete. The team provides a forum for leading to efficiencies in the planning process. The team also acts to ensure environmental features are not compromised during design and construction of the project.

A prominent suggestion by Federal and state agency respondents was the incorporation of long-term monitoring for environmental projects. Very little data about the biological response of implemented environmental projects exist, and its collection would advance the

development of future projects. In areas where long-term monitoring is being conducted, such as the Upper Mississippi River, agency respondents were pleased and felt the monitoring provided better direction for new projects being planned.

Respondents for Federal and state agencies indicated that their expertise is not utilized fully. For example, the U.S. Fish and Wildlife Service and other state environmental agencies have master plans developed for refuge areas that indicate what changes should be implemented and how it can be accomplished. Others, like the Soil Conservation Service, have some experience in the design and implementation of environmental projects. Sometimes this information is utilized, but in many cases it could provide efficiencies if used more extensively.

Special Interest Groups

Interest groups exert different effects on a project depending on their posture and attitude toward what is being proposed. The groups interviewed included nature-oriented agencies, sporting groups, landowners, farmers, and public awareness organizations. In many cases, the interest groups interviewed were supportive of a project being implemented, some to the extent of providing their expertise to the planning process. These groups were sometimes the impetus for a project, making local sponsors aware of the problem. Almost all interest groups interviewed felt the Corps Districts were attentive to their concerns.

The primary suggestion of interest group respondents was the need to incorporate recreational and educational values into project benefits. Groups were quick to indicate that environmental projects provide significant benefits to people as well as wildlife. Many of these project areas will provide a variety of opportunities for sporting groups, nature enthusiasts, and school groups. Elementary school groups will benefit from field trips in areas that accommodate them, and college and university students could benefit from field training.

A concern of interest groups was the need to examine a project area as part of a larger system. The groups noted that an implemented project affects more than the area for which it was designated; it also affects the hydrological cycle and animals that are not permanent residents of an area. The human population can also experience changes, such as socioeconomic or otherwise.

IV. CONCLUSIONS AND RECOMMENDATIONS

EVALUATION FRAMEWORK FOR ENVIRONMENTAL PROJECTS

The purpose of this research endeavor was to draw upon the perspectives of environmental planning practitioners to better understand the technical, political, and communication challenges faced in the Corps environmental plan formulation process. There are many challenges being addressed in the field, but it is clear that the Corps projects are a sample of all environmental projects. The environmental planning field maintains there is not a firm grasp on a methodology for determining the optimal project design or set of projects that maximize benefits to society. While there is not a dominant approach taking the process from beginning to end, there are some applicable techniques being utilized at the field level. Many of these were portrayed during the case study analysis, along with a full discussion of the challenges in environmental planning.

Environmental management is different than traditional Corps water resources management. Environment is a generalized concept, having different definitions depending on one's perspective. There is a very visible continuum of environmentalism across the country. In many parts of the nation, sporting groups represent the local environmental interest, which disappoints some of the "purer" environmental groups that suggest sporting groups are not environmentalists. Each project site is characterized by unique environmental features, both political and physical. For example, the environmental challenges being faced in Wyoming are clearly different than those in Kentucky. This difference goes beyond regional habitat and animal species; it also includes how locals perceive environmental improvement and how they want to pursue it.

This diversity of environmental settings across the U.S. makes "across-the-board" comparisons of environmental project merits very difficult. This is by no means a submission to the research question being addressed under EEIRP, the portfolio question, or an insinuation that it cannot be answered, thereby terminating the program. Rather, bounds should be placed on what can reasonably be accomplished analytically in the short term. The quest for a better understanding of single-site outputs is strongly encouraged. As the response to management options in terms of outputs, e.g., habitat units and wetland quality, is understood, it will logically feed the portfolio question.

Based on research activities of this study, the most likely candidate indicator for across-the-board comparison is HEP. This is because HEP appears to be a familiar method to most agencies. However, nearly all those who commented on HEP during the case studies and workshop made mention of its short-comings. Even if HEP is refined to better reflect the health of a particular species, the question of comparing species is still upon us (what is more important, a blue-winged teal or a canvasback?). The point here is that a better design for the site and a clearer empirical understanding of the environmental response address both the site and portfolio issues. The perspective based upon this research is that progress will most likely come first on the site challenge versus the portfolio challenge.

In terms of Corps expertise for environmental projects, District personnel appear to be very capable. Their ability to be responsive to issues at the site is, in many cases, hindered by the Corps bureaucratic structure. Very little technical design guidance for environmental projects comes from Division or Headquarters according to District personnel. The main avenue of support that comes from Headquarters is environmental policy—and oftentimes this is clouded because of the evolving Corps role in environmental projects. Given the unique and local nature (both technical and political) of each environmental project, most argued during the case study interviews (both Corps and non-Corps participants) that more plan formulation autonomy should be given to District personnel. In many of the case studies, decisions made above the District level were sometimes questioned by partners and the District, and many times these decisions were slow in arriving. This can place a tremendous strain on the working relationship with the partners in the planning process.

Review of projects within the Corps typically supports the technical integrity of the project. In the case of environmental projects, this system of technical checks and balances typically appears to be provided by the partners who possess a considerable amount of environmental expertise. In nearly all cases examined, the technical expertise required to design the proposed project and to anticipate the project's benefits was available at the site.

This is not to suggest that review by higher levels should be bypassed or removed; rather, the plan formulation process would benefit if more reliance was placed on the technical assessments of the Districts and local partners. This appears to be especially prudent in the near-term in light of the uncertainty associated with planning and designing environmental projects. Once standard environmental planning and design techniques have been established, higher levels will be able to more directly address the plan formulation challenges faced by field personnel as in other mission areas, such as navigation and flood control.

The most promising evidence of a robust, clear evaluation framework for environmental projects came from two case studies working under special environmental legislation directed

at a region. The Pool 8 Project in Wisconsin was built under the UMRS-EMP on the Upper Mississippi River and the La Branche Wetlands Project in Louisiana was funded through CWPPRA.

Each of these projects operated under special environmental, multiyear authorization from Congress, and each of these programs had a regional focus. Therefore, the availability for funding was assured (nearly) and geographically bounded. There was no analytical need, or pending threat, to justify the merit of these projects relative to projects in other regions of the country. The regional bounds helped to better focus on the environmental features. There was no potential for the real regional issues to be diluted with considerations of special environmental issues that are geographically remote. Each region has local diversity, but the limits in scope dictated by the funding authority caused the evaluation process to be manageable.

There are clear mandates in the UMRS-EMP and CWPPRA legislation, leaving little room for misinterpretation. In some of the other case studies, there was hesitancy on the Corps part to get involved, or the Corps participation was questioned by others. This tentativeness in Corps participation seemed to place the Corps in a less aggressive, sometimes reactionary role. This tentativeness was very evident in the Mayfield Creek Project, where it took some time for the Corps to take an environmental perspective, in turn causing some confusion among the project partners. At the time of the plan formulation for Mayfield Creek, very little precedence or technical support for accommodating flood control and environmental sensitivity was available, causing some cumbersomeness in the process. The UMRS-EMP and CWPPRA legislation allows the Corps Districts to march forthright into the project formulation procedure with very clear command support.

The UMRS-EMP and CWPPRA have active interagency groups that share in the evaluation procedure. The CWPPRA has fewer members, mainly because it is directed at one state, Louisiana. The Upper Mississippi projects consider not only Federal interests but state representatives from Minnesota, Wisconsin, Illinois, Iowa, and Missouri. With the larger group comes a wider range of issues and agendas, but they appear to be manageable. The interagency committees from each region meet regularly and are able to determine project priorities in their respective regions. Reports are published annually and are authored by the interagency group.

Efficiencies have been gained in every instance where interagency groups have been assembled. An effective task force should meet regularly, and should diligently encourage members to participate. Regulatory agencies that are critical to the approval of the project should be either a task force member or a recipient of meeting minutes. During the planning process, more communication should be promoted at critical junctures to reduce the chance of irritation related to partners that are not informed. An active interagency task force would

monitor project costs and would keep tabs on design options that would severely impact the local sponsors' ability to financially participate.

Trade-offs and negotiations play an important part in the prioritization, though they, for the most part, are informal. Because the interagency committees meet regularly, the roles of the members have time to converge and achieve equilibrium, allowing the group to operate efficiently. Another advantage is that the groups focus on their regions holistically. The technical merits of a project are considered based on the benefits to the system. There are additional technical and technology transfer advantages because the same group evaluates several environmental projects.

Media coverage has provided significant public support of projects where it has been used. Resistance by the public most often occurs when the public is not familiar with what purpose a project serves. The Jackson Hole and La Branche case studies both credit strong public backing to positive media coverage. Environmental projects generally find favor with the media and the public. Utilizing the media is a logical step to informing the public of project purposes and goals.

The evaluation framework adopted by the Corps should recognize the uniqueness of each project site, and furthermore recognize that the site is part of a system. Regional authorities designed with requirements for interagency involvement would best accommodate the real environmental needs in the region. Placing the bulk of responsibility for project evaluation within interagency committees' venue will limit bureaucratic bulk and assure responsiveness and technical accuracy. These features of an evaluation framework should be considered as the Corps implements its environmental mission.

RECOMMENDATIONS BY EEIRP WORK UNIT

The commentary and recommendations provided above are directed at the evaluation framework for the environmental project planning process. This next section focuses on recommendations according to the remaining EEIRP work units which play important, but segmented, roles in the project evaluation process. Many of the recommendations support ongoing efforts under the EEIRP and should be viewed as further justification for particular research. Some of the other recommendations may be used to redirect or change emphasis in an EEIRP work unit. Some of the findings presented below are based on what is perceived to be continuing needs for successful plan formulation activities.

There were many suggestions provided during the interview and workshop activities for improving the Corps environmental planning process. The final recommendations consider all of the data collected during this research effort and represent the authors' perspective of what is critical to enhancing the Corps environmental planning capabilities. Each recommendation is summarized in Figure IV-I according to the EEIRP work unit and how it interacts with the Corps plan formulation process. Provided below are each of the recommendations and associated discussion which are presented for each EEIRP work unit.

Determining and Describing Environmental Significance

1. Consideration should be given to the development of a resource list for Corps planners that indicates where information regarding environmental significance may be located.

A project area's environmental significance is often documented by another agency or group before the Corps becomes involved, as illustrated by the McFaddin Ranch Wetland Project in Texas' videotape and the availability of U.S. Fish and Wildlife Service refuge master plans. Research attention should be directed toward the creation of a catalogued handbook of possible sources that may have documentation, with examples. For instance,

State Resource Agencies	(e.g., State Wildlife Conservation Agencies, Water Resource Management Districts)
Other Federal Agencies	(e.g., U.S. Fish and Wildlife Service, Bureau of Land Management, Environmental Protection Agency)
Local Interest Groups	(e.g., Trout Unlimited, Sporting Clubs, Environmentalist Groups)
Computer-Based Literature Searches	(e.g., College/University Archives, Environmental Protection Agency Database)
Documented Legislation	(e.g., North American Waterfowl Management Plan, Coastal America)

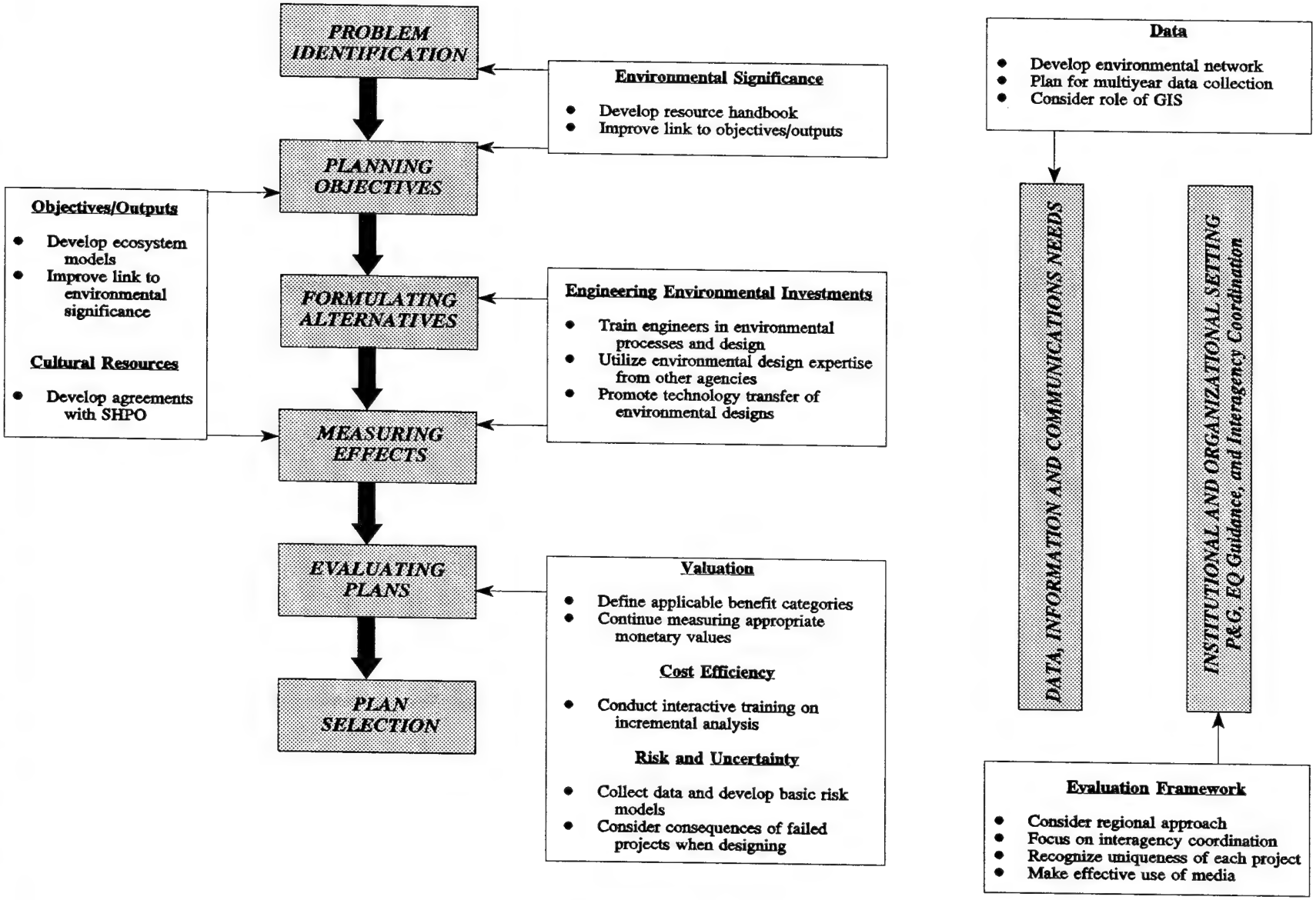

FIGURE IV-1
SUMMARY OF EEIRP-BASED RECOMMENDATIONS

In addition to enhancing information regarding environmental significance, these sources permit Corps planners to become more aware of potential stakeholders and resources that are available to assist with other segments of the planning process.

Determining Objectives and Measuring Outputs

2. Research efforts should be directed toward the location and/or development of an ecosystem model that better represents the habitat being developed. This model would be incorporated into guidance as a standard for the planning of Corps environmental projects.

Species-based models of environmental outputs, such as the USFWS HEP, are well recognized throughout the environmental planning community. HEP has been applied many times to describe the outputs of a wetland or environmental region, and the model has also been revised quite often or adapted for a particular case. Despite the popularity of these models, there is general agreement that they do not adequately represent the environmental system affected by the proposed project. Furthermore, HEP-type models require a considerable amount of subjective input. Thus, an investment in the development of ecosystem models based on physical measurement is recommended.

The Wetlands Valuation Assessment that was used as the standard for evaluating habitat in the Coastal Wetland Planning, Protection, and Restoration Act projects in Louisiana was fairly well-received by the respondents from the New Orleans District and the Louisiana Department of Natural Resources. This model does require subjective judgements, being a regional version of HEP. The main difference, though, is that it is a community-based versus species-based model. This model may be a point from which to start.

3. Research should be directed at developing guidance for creating a logical and explicit connection among environmental significance, project objectives, and measurable outputs.

In the case of environmental projects, a clear link between the project's environmental significance and the project's objectives and associated outputs is very important. This linkage/flow is especially pertinent for environmental projects where clear and/or accepted means of quantification are relatively weak at this point in time. The statement or description of environmental significance and the justification of why the project is in the Federal interest may be the strongest segment of the proposal. Thus, explicit interaction with the statement of

significance when developing the objectives and outputs will, in turn, strengthen the presentation of objectives and outputs.

In many instances, confusion among the planning partners has developed because the foundations of the proposal are not well-developed. There may be a cursory understanding in the beginning of the planning process of the project purpose and the intended products, but further in the planning process where other details are the focus, it is very easy (and common) for partners to lose sight of "what they are really doing." If there is a solid connection between environmental significance and project objectives and outputs, this disorientation will be less likely.

Objective Evaluation of Cultural Resources

4. Formulate working agreements with State Historic Preservation Offices regarding appropriate measures for the evaluation of cultural resources during the planning process.

Corps archeological personnel from several case studies emphasized the importance of forming good relationships with their respective State Historic Preservation Offices. The formulation of working agreements with the state agencies provides a clear understanding to both agencies regarding what the examination requirements are for cultural resources in the planning and construction of environmental projects. The document should contain provisions for areas that have already been examined, and what steps are to be followed if a cultural resource is discovered.

Engineering Environmental Investments

5. Corps engineering personnel should receive more environmental training.

The case studies illustrate difficulties experienced in the engineering of environmental projects because of the engineers' lack of familiarity with ecological functions. This caused significant delays because suggested designs did not meet the desired biological results. Related courses and workshops are offered by the IWR and WES, and through the Corps PROSPECT course program in Huntsville. If the Corps is to make a successful transition of their mission toward environmental restoration, engineers need to be more familiar with ecosystem management techniques to design appropriate alternatives. The Texas Department of Parks and

Wildlife is one example of an agency that offers week-long courses in ecological management, more specifically for marshes. A curriculum of environmental training should be developed from courses taught at colleges, universities, technical schools, Federal and state agencies, and commercially available seminars and workshops. Although the Corps generally encourages continuing education and provides opportunities for Corps employees in this regard, special focus is suggested for environmental design. Furthermore, it is recommended that these courses be attended by personnel representing the many disciplines involved in planning environmental projects including engineers, economists, biologists, and planners.

6. Attempts should be made to use the technological advances of other Federal agencies to develop a handbook of resources regarding the design and development of engineering alternatives for environmental projects.

Throughout the case study process, most Corps planners and engineers were unaware of potential engineering designs for environmental projects. In the case of the McFaddin Ranch Wetland Project in Texas, the implemented alternative was discovered through a chance meeting. Federal and state conservation agencies have more experience in developing environmental projects because of the nature of their missions. Guidance that is developed should provide a handbook of sources that could contribute to the development of environmental projects.

7. The development and distribution of innovative environmental engineering designs should be promoted.

Although there are some approaches to the engineering of environmental projects, the field is still in the early stages of development. The Corps can gain credibility in the environmental community through the research and development of new engineering approaches. Guidance for such an effort should encourage careful field experimentation and documentation results. The results of the innovations, as well as basic techniques, should be collected and reported so that Districts can use them in future environmental planning and design activities. This dissemination of techniques could be carried out through simplistic means such as newsletters or conferences, or could be developed using computer technology, such as expert-systems.

Monetary and Other Valuation Techniques

8. Guidance should be developed that clearly defines benefit categories that are required/appropriate for feasibility studies and reports.

Difficulties have been experienced at all levels of the Corps hierarchy regarding benefits that are appropriate for presentation in feasibility study reports. First, there is not a working understanding of what benefit categories are applicable for each type of Corps project (e.g., Section 1135 authorization). Present guidance often alludes to output categories as primary or secondary. But clarity is needed to indicate which benefit categories are really applicable, versus categories simply mentioned for the sake of completeness. In other words, if recreation benefits can be tabulated as secondary outputs, is it worth the Districts' time to conduct the analysis of recreation benefit values or environmental projects?

The other need for guidance and research is discriminating the type of benefit categories according to project size or planning resources. Definition of benefit estimation techniques for a small project versus a large project would create efficiency in the planning process because it would provide clear direction and there would be less time wasted on speculation of which methodologies are required.

9. Research should be directed toward determining and developing monetary and other valuation techniques.

Although there is consensus that environmental projects provide benefits to society that cannot be measured in monetary terms, this does not mean that monetized benefits should be disregarded. Recreation and flood control are obvious categories of benefits where the Corps has utilized traditional economic-based techniques to create dollar-value benefits. The intent is not to make the project approval or prioritization decision based upon dollar values; rather it would provide support for the project justification analysis.

Cost-Effectiveness/Incremental Analysis

10. Training and workshops should be conducted on the purpose, intent, and mechanics of incremental analysis.

Incremental analysis is an appropriate means of identifying the best project alternative in terms of dollars per unit of output. The technique has received considerable technical support from HQUSACE and it has been successfully applied at selected Corps projects. Presently, though, incremental analysis is reluctantly utilized by Corps Districts, and, in many cases, it is utilized mainly to appease HQUSACE.

A great deal of this reluctance would be relieved through interactive training of incremental analysis. The training should be attended by members of District, Division, and HQUSACE, and the purpose and intent of incremental analysis should be examined in detail. Interaction among the training participants would help alleviate the misunderstandings associated with incremental analysis in the project approval process.

The training should be attended by economists, ecologists, engineers, and study/project managers. Incremental analysis is often viewed as a technique for economists, but the critical inputs, such as environmental outputs, come from the environmentalists in the Corps. The interaction among the different disciplines will serve the process very well and will help define the technical limits of incremental analysis.

Common technical challenges should be explicitly addressed in the training, such as how to formulate alternatives and its application to small projects. Communication of results within and outside the Corps should be addressed. Each of these issues should be approached using real examples whenever possible.

Incorporating Risk and Uncertainty in Environmental Projects

11. Identify environmental models that can be characterized in a risk framework and concentrate data collection efforts to support development of probability distribution.

The concepts of risk and uncertainty are utilized informally within the Corps environmental planning community. The likelihood of a series of events leading to a result has uncertainty inherent in the process. Risk and uncertainty could be formalized if more was known about the likelihood of success (or failure) of each of the events in the series. Hence, probability distributions around important segments/models in the environmental improvement or enhancement process should be formed.

Development of understanding risk and uncertainty for environmental projects to the degree the Corps analyzes flood control and hydropower outputs will require a great deal of data

collection and is probably years, even decades, in the making. The prerequisite is, of course, to get an empirically sound understanding of environmental outputs. A concerted effort toward a selected segment of a large scale environmental model will be an important step in the right direction.

A common environmental process that is most likely to be quantifiable should be identified. Next, a formal data collection effort should be designed and executed to support the development of probability distributions. The likelihood of success and related confidence bounds could be established around the expected value. The planner will then be able to express with empirical confidence the results of the intended design. This process should be carried out for the critical segments of common environmental systems until a comprehensive model is complete.

12. Consider the consequences of a failed environmental project in the engineering design.

Many of the environmental projects are created by moving, holding, or draining water—the same general engineering role of traditional projects (e.g., flood control) built by the Corps. The structural integrity of the traditional projects is very sound, recognizing that human lives and property are at stake. This approach is warranted when flood control projects are built to protect property. Failure of environmental projects do not have such a disastrous human effect. Therefore, the Corps should consider relaxing design standards for environmental projects which would enhance cost-effectiveness. This tempering should be approached cautiously and should be considered only when the possibility of significant damages is very remote. Less risk-averse levee designs have been successfully created and built by some non-Corps agencies involved in the CWPPRA projects.

Procedures for Developing and Integrating Environmental Databases

13. Research should be conducted to determine the feasibility of developing an accessible computer database for environmental project planners.

Because the environmental field is still in early developmental stages, approaches to planning and designing environmental projects are not well known. Many planners expressed frustration regarding where to access such information and felt there should be a computer database within the Corps that could accommodate this need. The information in such a system should be comprised of engineering approaches, environmental management approaches, and

summaries of environmental projects that document their results as well as traditional environmental and hydrologic data.

14. Multiyear monitoring should be conducted for projects after they are constructed to assist with future environmental planning endeavors. Equipped and experienced colleges and universities should be utilized when possible.

Limited data exist regarding the monitoring of environmental projects after they are implemented. The ability to create accurate and dependable environmental models is dependent upon collection and management of data that describe the environmental system processes, results, and factors that influence results. Good models and databases lead to many other analytical opportunities that support the planning process, such as measuring outputs, incremental analysis, and risk analysis. Several case studies throughout the present report suggest the need for improved environmental data and models.

The case studies also illustrate the effective use of college and university personnel and students in the development of environmental projects. Some schools have well-developed biological or ecological programs where significant field research has been conducted. Their familiarity with the biological functions of the area can provide valuable contributions to the planning process. Care should be taken to use professors and graduate students who have had time to develop their field-monitoring skills.

15. Research should be conducted to determine the role that Geographic Information Systems (GIS) should play in the planning of environmental projects.

A GIS provides planners with a valuable tool for developing environmental projects. The St. Paul District is an example of how successful implementation of a GIS can enhance the planning process. There is a long-term data collection effort underway for the UMRS-EMP, and these data have been used to design a number of projects. The start-up costs for a GIS are substantial, especially for data collection, but because it is used for a number of projects within the St. Paul District, the GIS has proven to be a cost-effective planning tool.

Other Districts recognize the value of this technology, but currently do not have enough projects in their area for a GIS to be cost effective. The research for this recommendation needs to address what services a GIS can provide to Districts and identify strategic locations for the placement of a GIS that could be used by multiple Districts. Guidelines for identifying the threshold for justification of a GIS should be developed.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 1995	

4. TITLE AND SUBTITLE
Compilation and Review of Completed Restoration & Mitigation Studies in Developing an Evaluation Framework for Environmental Resources Volume I

5. FUNDING NUMBERS

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
IWR Report 95-R-4

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Headquarters
U.S. Army Corps of Engineers
20 Massachusetts Ave., NW
Washington D.C. 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release;
Distribution Unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
This is Volume I of a two volume set and the first of a series of interim reports which will be published under the Evaluation Framework Work Unit of the Evaluation of Environmental Investments Research Program. Volume I documents, from 10 case studies, an initial effort to identify the important planning issues presently being faced by Corps planners. This effort was conducted from March through November of 1994 by conducting a focus session with Washington level reviewers and by conducting a large number of interviews with Corps and non-Corps study team members. A comparative analysis identifies the important themes that emerged from this effort. Recommendations and future needs are also discussed in this Volume.

14. SUBJECT TERMS
Evaluation Framework, Case Studies, Significance, Objectives, Outputs, Cultural Resources, Engineering Monetary, Other Valuation, Cost Effectiveness

15. NUMBER OF PAGES
67

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	Same as Report